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Detroit District

Great Lakes Update

Nature's Effect on Great Lakes' Water Levels

As we begin another recreational boating season, there is great interest in Great Lakes water levels, particularly since we are in a period of low water levels. The current water level regime on the Great Lakes is due to a variety of natural factors that have been acting on the five-lake system over the past four years.

Water levels can increase or decrease depending on the amount of inflow coming from the upper lakes, surface runoff draining into each lake, groundwater recharging the lakes, precipitation falling directly on the water surface, evaporation from the lake surface, and outflow to downstream lakes. Other natural phenomena that affect water levels are ice in the connecting channels and the St. Lawrence River, aquatic weed growth in these rivers, changes in barometric pressure, wind, and crustal movement of the earth.

In this article, we will discuss recent water level trends and relate those trends to underlying natural factors, such as snow pack, rainfall, and evaporation. The article will provide a perspective by comparing current water levels to historic ranges and trends.

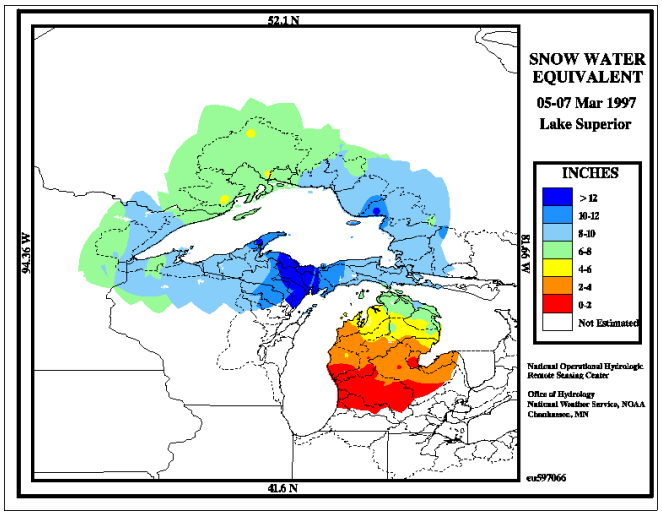
Is This Really the 'Snowbelt'?

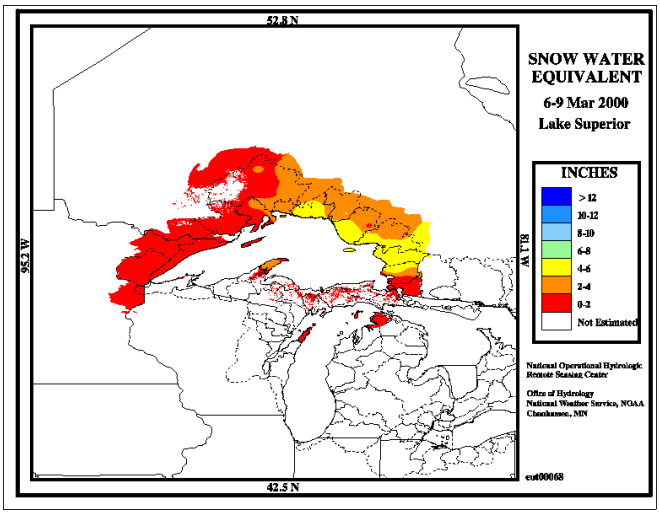
The Great Lakes region is notorious for its cold, snowy winters. The last few winters, however, have been anything but cold and snowy. This past winter, we finally saw a return to a more typical winter across the basin. December 2000 will be remembered for one of the worst combined cold and snowy Decembers on record. A steady conveyer of Arctic air developed early in the month and continued right into January.

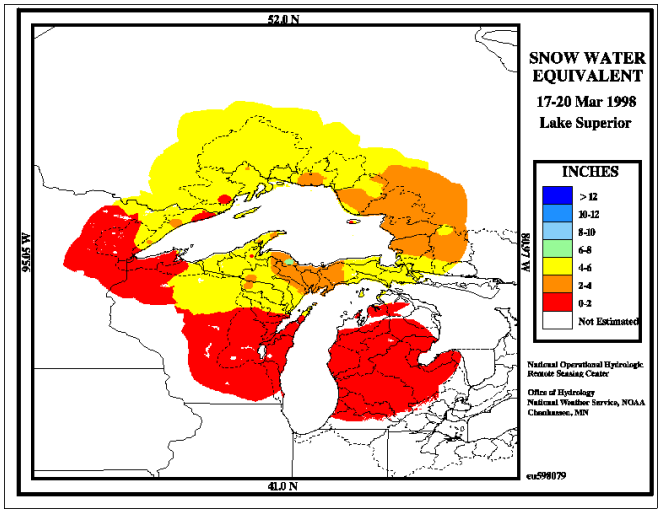
High evaporation also occurred, however, as the bitter, dry air crossed the relatively warm waters of the Great Lakes. The resulting intense lake-effect snows and enhanced storm systems quickly resulted in a deep snowpack in the snowbelt regions and southern Great Lakes. Lake-effect snow does add to the snowpack, but it does not really add moisture to the basin. Lake-effect snow is really 'borrowed' water from the lake that is returned later in the season when the snow melts.

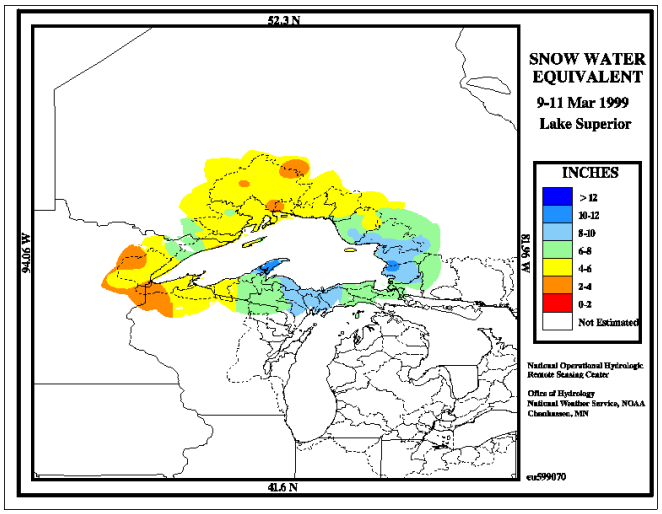
The amount of snow that falls each winter is a critical indicator of where water levels will peak the following summer. The National Weather Service conducts an airborne snow survey for the Corps of Engineers every March to determine the water content of the snowpack around the Lake Superior basin. The amount of water in the snowpack in early March is an important indicator of summer water levels in all the Great Lakes.

For example, a near-record snowpack in 1997 and persistent spring rains produced water levels in Lake Superior near record highs in the summer of 1997. However, 1997 was followed by three years of below-average snowpack. Snow survey graphs from 1997 through 2000 are shown on the following page.

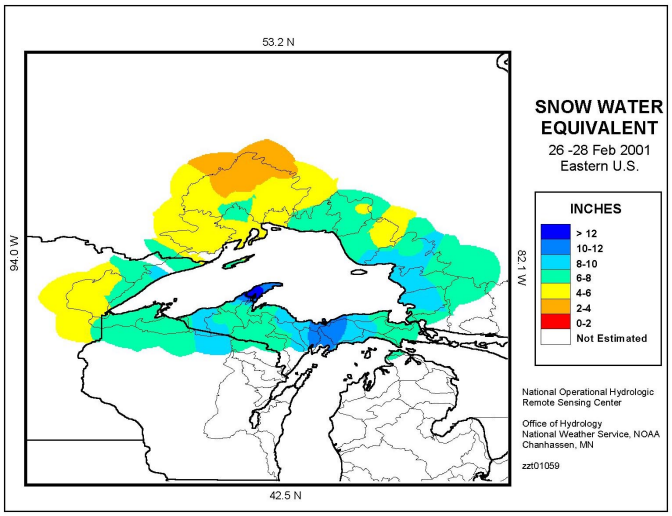








Reviewing the snow pack sequence of the past four winters, it's easy to see why we are currently experiencing low water levels. This year's snow survey results, however, brought a welcome reversal to that trend. As shown below, the 2001 snow survey showed a snow pack significantly above average.



After reviewing this year's snow survey results, forecasts for summer water levels were revised slightly upward. Still, the snow deficits from the past three seasons cannot be recovered in one year. Therefore, although the forecast was revised upward, the forecast for Summer 2001 calls for peak water levels lower than last summer's levels.

April Showers Bring...Water Levels Up

Spring rains that typically hit the Great Lakes in April through June supplement snowmelt and together produce a seasonal rise in water levels on the Great Lakes. Last year, above-average spring rains offset the very low Lake Superior snowpack and kept the lakes on course with their seasonal rise.

After a prolonged dry spell, soil moisture levels are low and a greater percentage of precipitation soaks into the ground, rather than running off and adding directly to the lakes' water supply. Groundwater levels also decrease during dry years and thus do not contribute as much to the lakes.

Annual precipitation in the Lake Superior basin was 13 percent below average in 1997 and 4 percent below average in 1998. This, combined with the below-average snowpack during that time, contributed to the below-average water levels throughout the basin.

Water levels always increase in the spring with snowmelt and spring rains. Average or above average spring rains this year would help supplement snowmelt in the lakes' seasonal water level rise during the beginning of the recreational boating season. Without substantial spring rains, however, water levels likely will peak lower this summer than last. Spring and summer rainfall is also important because it slows evaporation.

Warm Water and Cold Air Increases Evaporation

The evaporation process is an invisible but very significant factor in the loss of water from the Great Lakes. During prime evaporation periods, the lakes can lose up to 1 to 2 inches of water per week due to evaporation.

Maximum evaporation occurs when the water temperature in the Great Lakes is much warmer than the air moving across them. This occurs particularly in the fall before the lakes have a chance to develop an ice cover. This past December is a good example of that process. With the very cold arctic air mass over the region in December, the water temperature was significantly higher than the air temperature. Consequently, there was a much higher evaporation rate from the lakes in December, as illustrated in Figure 1.

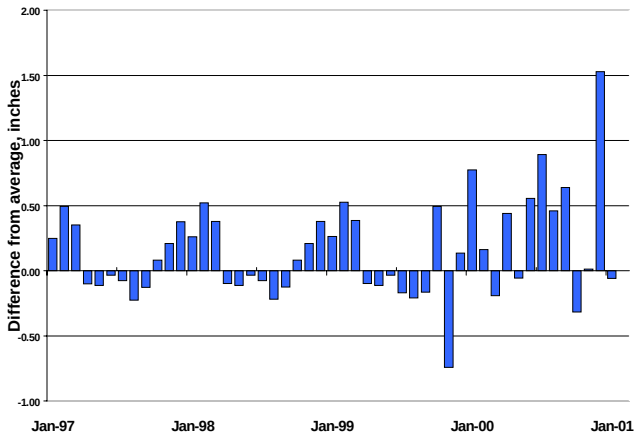


Figure 1. Evaporation from Lake Superior 1997-2000

Above-average temperatures that persisted in the Lake Superior basin in 1998 and 1999 produced warmer than average water temperatures, which delayed the development of an ice cover. Without ice cover, evaporation from the lakes increases dramatically during the winter months. As shown in Figure 1, monthly evaporation on Lake Superior was above average more than two-thirds of the time since January 1997. Cumulatively over those three years, evaporation from Lake Superior was over seven inches above average. This illustrates that evaporation is yet another factor that has contributed to the lower water levels on the upper Great Lakes in the past several years.

Recent Water Level Trends

Over the past four years, residents and users of the Great Lakes have witnessed a dramatic shift

in the water level regime in all of the Great Lakes. Between 1997 and 2001, water levels on Lakes Superior and Michigan-Huron dropped from within inches of the record high to within inches of the record low. Although the 2000-2001 winter season brought more snow to the Lake Superior basin, water levels are expected to peak at a lower level this summer compared to last. In addition, Lakes Michigan, Huron, St. Clair, and Erie are expected to peak earlier than they have historically. Figure 2 illustrates the sharp decline in Lakes Superior, Michigan, Huron, and St. Clair since 1997.

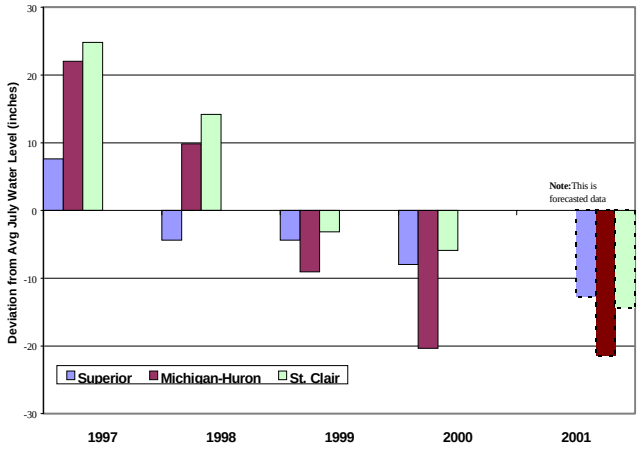


Figure 2. July water level deviations from average in Lakes Superior, Michigan-Huron, and St. Clair

In addition to the lower water levels in the past several years, dry conditions can produce earlier peak summer levels, and consequently, earlier declines in water levels. Levels typically peak in the middle lakes in July and begin their seasonal decline after that. In 1998, all five Great Lakes peaked two months early and thus began their seasonal decline early in the summer. Last year, heavy spring rains helped prevent an early peak despite the lack of snowpack.

It's interesting to compare the low water levels we are currently experiencing with the trends over the past 30 years (Figure 3). Since the record low water year of 1964, water levels on Lakes Michigan-Huron trended above average for about 30 years. Since we have enjoyed above-average water levels for the better part of 30 years, the low water levels we are currently experiencing seem that much lower.

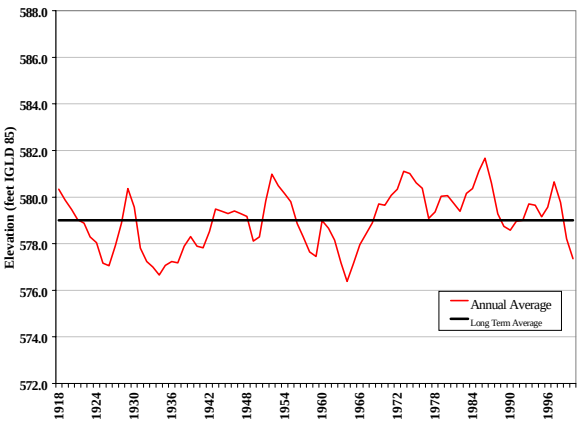


Figure 3. Lakes Michigan-Huron historic water levels from 1918 to present.

Figure 3 also shows that the low levels we are currently experiencing have occurred in the past, in the mid 1930s and the mid 1960s. It's also interesting to note that before the 1970s, water levels tended to be well below average for several years at a stretch. In this context, the current low levels that we are experiencing seem to be just part of the natural course of events that governs the lakes' hydrology.

While scientists continue to speculate about the effects of climate shifts, global warming, and long-term cycles on water supply in the Great Lakes basin, recent water level trends illustrate that levels continue to exhibit a natural variability

Meetings

The International Lake Superior Board of Control (ILSBC) will hold its 2001 annual public meeting on June 27 in Port Severn, Ontario on Georgian Bay. The meeting will be held at the Inn at Christie's Mill from 7:00 p.m. to 9:00 p.m.